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PROTECTION AGENCY

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May 30, 2003
B-09075-0144-0804
REPA3-0804-023

Ms. Linda Bowling
EPA Regional Project Officer
U.S. Environmental Protection Agency
999 18th Street, Suite 300
Denver, CO 80202

Subject: EPA Contract No. 68-W-02-022, Work Assignment R08204, Review of RCRA Corrective Action Work Plans and Reports for RCRA Facilities, Task 2, ASARCO East Helena Facility; East Helena, Montana

Dear Ms. Bowling:

In response to Work Assignment R08204, Task 2, under EPA Contract No. 68-W-02-022, Booz Allen Hamilton (Booz Allen) reviewed the *Draft RCRA Facility Investigation Report, March 2003* ("the Report") prepared for ASARCO Inc. by ASARCO Consulting Inc. Our review comments are provided in the first attachment.

An explanation of our review of ASARCO Data Validation Reports (DVRs) performed as part of the Report review is provided as a separate attachment. This second attachment identifies the validation reports selected for review and details the verification activities. No apparent deficiencies were found in review of the DVRs. However, the DVRs for subsurface soil samples are missing from Appendix 7 of the RFI Report, and this problem is cited in General Comment 15 in the RFI review comments.

The review comments identify severe deficiencies in the Report, and recommend additional investigations that are necessary to fully characterize hazardous constituent releases at and from the ASARCO Facility. The extent and rate of migration of releases, human and ecological exposure pathways, and potential receptors are not adequately characterized. Key new findings in the Report include substantial contamination of the railroad right of way northwest of the smelter boundary, but the extent of releases westward along the rail corridor has not been determined.

As you review this information, please do not hesitate to call Julie Skeen at (303) 221-7548 or Greg Starkebaum at (303) 221-8268, if we can provide further assistance or answer any questions.

Sincerely,

Julie K Skeen for

Karon Brown Gilmore, P.E.
Region 8 Regional Manager

BOOZ ALLEN HAMILTON

Enclosure

cc: Thomas Valentino, EPA Contracting Officer (cover letter only)
Susan Zazzali, Work Assignment Manager
BAH PMT QA/QC Coordinator

M-30346
L4-3

TECHNICAL REVIEW COMMENTS
RCRA Enforcement, Permitting, and Assistance (REPA), Zone III
Contract No. 68-W-02-022
May 30, 2003

Work Assignment: R08204, Review of Corrective Action Work Plans and Reports for RCRA Facilities, Task 2: ASARCO Corrective Action Work Plans and Reports

Deliverable: REPA3-0804-023

Document: *Draft RCRA Facility Investigation Report, March 2003,* prepared for ASARCO Inc. by ASARCO Consulting Inc. ("the Report")

Basis For Review: *Remedial Investigation of Soils, Vegetation and Livestock for East Helena Site (ASARCO), East Helena, Montana, May 1987,* Prepared for US EPA Hazardous Site Control Division by CH2M Hill, Montana State University, et al ("Phase I RI Report")

Comprehensive Remedial Investigation / Feasibility Study, ASARCO Incorporated, East Helena, Montana, March 30, 1990 prepared for ASARCO Inc. by Hydrometrics Inc., Roy F. Weston and Hunter/ESE ("Phase II RI Report")

RCRA Corrective Action Plan, OSWER Directive 9902.3-2A, May 1994, US EPA Office of Solid Waste and Emergency Response

Consent Decree, Civil Action No. CV 98-3-H-CCL, United States of America, Plaintiff v. ASARCO Incorporated, Defendant United States District Court for the District of Montana, Lodged January 23, 1998 ("Consent Decree")

Current Conditions / Release Assessment, East Helena Facility, January 1999 prepared for ASARCO Inc. by Hydrometrics Inc. ("CC/RA")

Final RCRA Facility Investigation Work Plan, December 2000, prepared for ASARCO Inc. by Hydrometrics Inc. ("RFI Work Plan")

Interim Measures Work Plan Addendum, East Helena Facility, April 2002, prepared for ASARCO Inc. by Hydrometrics Inc.

East Helena Area Public Water Supply Wells, Updated Public Water Supply Well Map prepared by Montana Department of Environmental Quality, dated 5-28-02

Minor Clarification of National Primary Drinking Water Regulation for Arsenic, US EPA, Federal Register 68 FR 14501, March 23, 2003

City of East Helena Public Water Supply Source Water Delineation and Assessment Report, prepared by the University of Montana-Helena, Lewis and Clark Water Quality Protection District and East Helena Public Water Supply, November 2002 ("City of East Helena Public Water Supply SWDAR", or "the SWDAR")

Ecological Risk Assessment Guidance for Superfund, US EPA, 1997 ("ERAGS")

ECO Update Number 12: *The Role of Screening -Level Risk Assessments and Refining Contaminants of Concern in Baseline Risk Assessments*, EPA 540/F-01/014, 2001

ECO Update Number 13: *Ecological Risk Assessment at Superfund and RCRA Corrective Action Sites*, February 2001

Guidance for Characterizing Background Chemicals in Soil at Superfund Sites, OSWER Directive 9285.7-41, 2001

Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, US EPA, 1989, and 1992 addendum

Role of Background in CERCLA Cleanup Program, OSWER Directive 9285.6-07P, 2002

GENERAL COMMENTS

1.0 INTRODUCTION (page 1-1)

1. The second paragraph of the introduction states that the reason for transfer of the ASARCO East Helena facility from Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to Resource Conservation and Recovery Act (RCRA) corrective action jurisdiction was that "EPA determined that RCRA is better suited for application to operating industrial facilities than is the CERCLA program..." Although this is a partially true statement, it does not acknowledge the primary basis for placement of the facility under the authority of the RCRA program. As detailed in the Consent Decree in Civil Action No. CV 98-3-H-CCL, (Consent Decree), Section VII, paragraph 21, Basis For Corrective Action Jurisdiction: "ASARCO admits that it accepted and stored without a RCRA permit or interim status approximately 166 drums of spent caustic waste in the period February-April 1996. Approximately one-half of this spent caustic waste was charged to the blast furnace. For purposes of this Decree, ASARCO concedes that is should have had a permit or interim status to receive this material under hazardous waste manifest and, accordingly, EPA has corrective action authority at the facility." ASARCO's use of the blast furnace and attached air emission control equipment as a waste disposal or treatment system is the primary reason the Facility is now under RCRA jurisdiction. Insert this quotation and a reference to the Consent Decree to replace the above sentence in the Draft Report.

1.1 FACILITY BACKGROUND (page 1-3)

2. The ASARCO East Helena smelter (the facility) description is limited to a few sentences and a reference to Section 2.0 of the Current Conditions and Release Assessment (CC/RA) for "greater detail." However, neither the CC/RA Report nor the Draft RCRA Facility Investigation (RFI) Report ("the Report") provide an operating history of the facility, the current ASARCO facility property boundary, the history and reasons for ASARCO land acquisition around the facility, the regulatory history of the facility, nor the full scope of remedial actions performed under CERCLA requirements during the last decade. For example, there is no mention in the Report or

the CC/RA of the air emissions control equipment installed at the facility during the mid-1990s, the replacement of soil in residential yards in East Helena, and placement of East Helena soil on ASARCO property east of the smelter. Similarly, neither the Draft RFI Report nor the CC/RA provides details on the locations and volumes of contaminated soils excavated within the facility boundary and placed in the Corrective Action Management Unit west of the smelter. This background information is necessary to provide the basis for understanding the existing situation at the facility. Revise Section 1.1 to provide a detailed discussion of the above information, including quantitative measures, e.g., volumes of soil and concentrations of hazardous constituents, where available.

1.4 RFI PURPOSE/OBJECTIVES (page 1-17)

The ASARCO RFI Purpose/Objectives stated in the Consent Decree Section VII, paragraph 43; the RFI Work Plan Section 2.1; and the Draft RFI Report Section 1.4, include broad goals as required under the RCRA statute and regulations. The Purpose/Objectives include:

- Characterize the source(s) of hazardous waste or hazardous constituent releases or potential releases of any hazardous waste or hazardous constituent
- Identify and determine the nature, extent, and the rate of migration of releases of hazardous wastes or hazardous constituents at or from the facility
- Determine the likely routes of migration of releases of hazardous waste or hazardous constituents, if any, at or from the facility including characterization of the geology and hydrology of the facility
- Determine the degree and extent of, or threat of, migration of releases of hazardous waste and hazardous constituents at or from the facility
- Identify actual and potential receptors
- Support the development of corrective measure alternatives
- Be definitive enough to support the selection of corrective measures.

Major concerns regarding the adequacy of the Report in meeting each of these objectives are explained in the following six general comments.

3. The first general concern regarding failure to meet the RFI objectives is the absence of information regarding the facility air emissions sources, i.e., the sinter plant, acid plant and other stacks, and fugitive dust emissions. The Report does not identify the stacks or dust as hazardous constituent release sources. Contamination of soil within and outside the immediate boundary of the smelter property resulting from air emissions is not acknowledged, except by minimal references to the historical Remedial Investigation (RI) Reports. Releases of hazardous constituents from these sources have resulted in contamination of the Helena Valley for several miles in all directions from the facility, as documented in the 1987 Phase I RI Report, but this basic fact is not acknowledged in the Report. The exclusion of air emissions is stated in Section 5.1: "Offsite receptors from air pathways were addressed as part of the CERCLA and National Ambient Air Quality Standard programs. Therefore they are not addressed in this RFI Site

Characterization Report." The Report does not attempt to demonstrate the adequacy of previous air emission evaluations to meet RCRA Corrective Action requirements. The relevance of the NAAQS program to the current condition of the Facility is not explained, and evaluations or conclusions from these programs that might be relevant to RCRA requirements are not specifically referenced. Even if off-site releases were to be exempt from RCRA requirements, the on-site surface soil contamination must be acknowledged as largely due to air emissions. The Consent Decree does not provide for exclusion of air emissions or off-site releases in specifying the requirements for a full RCRA Facility Investigation (RFI). Section VII, Statement of Requirements, paragraph 22.e. of the Consent Decree states that, among other requirements, ASARCO will: "**Perform a RCRA Facility Investigation ("RFI") to determine the full nature and extent of any and all releases of hazardous wastes and/or hazardous constituents at or from the Facility.**" The Report must be revised to identify air emissions from the facility as hazardous constituent releases, and the extent of migration of these releases must be acknowledged. Previous investigations or evaluations that may partly meet RCRA site characterization and risk assessment requirements should be specifically referenced. If such documentation was not previously submitted to EPA it must be provided as an attachment(s) to the Report.

4. Some of the Phase II RI data for soil samples collected in 1987 are used in combination with 2001 sample data in the Draft RFI Report. Additional releases resulting from operation of the facility until 2001 (that may have accumulated at the historical sample locations) are not considered or accounted for in the Report. Extensive on-site soil excavation and placement of off-site soil on ASARCO property during the 1990s are also not described or summarized in detail, although that work may have resulted in removal of soil at some of the 1987 sample locations. The adequacy of the Phase II RI data to represent current conditions at the facility must be discussed in the revised Report.

5. Off-site contamination of soil in the rail corridor leading into the facility is documented in new data provided in this Report, e.g., Exhibit 3 and Appendix 7, but the data are barely referenced in Section 2.3 of the Report (one Toxicity Characteristic Leaching Procedure result for lead is mentioned). The extent of contamination of the rail corridor is not addressed. For example, analyses of the rail corridor surface soil samples furthest from the plant site (transect RCSA-8, approximately 2,000 feet west of the plant) include lead, cadmium and arsenic at concentrations above 58,000 mg/kg, 800 mg/kg and 3,800 mg/kg, respectively, but this evidence of hazardous constituent releases is not mentioned in the text of the Report. The Report must be revised to identify ore transport rail cars as apparent release sources. The incomplete characterization of the extent of contamination of the rail corridor, and the potential for exposures to railway workers and the public, must be fully discussed in the revised Report. The unknown extent of railroad right of way contamination should be identified as a major remaining data gap.

6. The Report fails to consider several additional hazardous constituents that were released during operation of the facility. Mercury, thallium, selenium, and silver are hazardous constituents listed in Appendix VIII of 40 CFR 261. These hazardous constituents have been released from and on the facility site along with arsenic, cadmium and lead, and were reported in soil samples adjacent to the facility at concentrations one to two orders of magnitude above their respective background concentrations (Phase I RI Report, page 3.11). Much higher on-site concentrations of these hazardous constituents, and barium, another hazardous constituent, were documented in the Phase II RI Report and more recent investigations. The only stated explanation for the failure of the RFI to address these hazardous constituents (except for analyses of five groundwater

samples and soil samples from one location; which are not discussed in the text of the Report) is provided in the ASARCO Response to EPA General Comment number 10 (dated June 12, 2000), provided with the Final RFI Work Plan. The ASARCO Response stated that "...the metals listed in the comment were below levels of concern," "concentrations of these parameters at most location[sic] were below analytical detection limits," and "EPA felt that an indicator parameter approach was appropriate" for the Phase II Remedial Investigation. The first two rationales are questionable for groundwater, demonstrably incorrect for soils, and all three are undocumented in the RFI record. The "appropriate approach" for the 1984-1987 investigations at the facility was developed in part to cope with extreme cases of hazardous materials contamination, which were addressed by extensive on-site and off-site soil excavation and other remedial measures that are barely mentioned in the Report. The approach that is appropriate for characterization and assessment of the remaining unremediated releases is to include all of the hazardous constituents that were released. For example, the 1987 maximum on-site surface soil concentrations and "enrichment factors" (geometric mean of on-site samples divided by the geometric mean of background samples) for these four hazardous constituents were (from Phase II RI Report, Table 5-1-9):

Hazardous Constituent	Max. On-site Surface Soil (ug/g)	Enrichment Factor (no units)
Mercury	360	124
Thallium	515	589
Selenium	518	701
Silver	214	611

Higher concentrations of each of these hazardous constituents have been determined in on-site subsurface soil samples. The APSD-P sample series (data provided on pages 118 through 123 in Appendix 7 but "Not Discussed" in the Report, as noted in the database index), collected in 1996, indicate an apparently large volume of contaminated soil with barium at concentrations up to 2,600 mg/kg; and mercury concentrations up to 36,000 mg/kg, i.e., 3.6% by weight. Regardless of the previous rationale for not addressing these hazardous constituents, the RFI Report cannot meet the objectives of determining the nature and extent of hazardous constituent releases, rates and likely routes of migration, and the cumulative degree of risk to potential receptors, without addressing these elements. The Report must be revised to comprehensively address these five hazardous constituents and any others that are known (to ASARCO) to have been released at or from the facility.

7. Potential receptors of hazardous constituent releases are not adequately identified in the Report, although a significant off-site population is located immediately adjacent to the facility. The discussion of potential receptors in Section 7.1.1 contradicts the referenced generic Figure 5-1-1, which shows many completed exposure pathways. Identification of exposed on-site and off-site workers as receptors in Section 7.1.1 does not meet the RFI objective of identifying (all) potentially exposed receptors. Exposures to ASARCO releases have been documented in previous investigations, particularly the Montana Department of Health and Environmental Services and Centers for Disease Control 1983 *East Helena, Montana Child Health Study*, referenced in the Phase II RI Report, Section 5.1.1.4, and the ongoing State and County-administered child lead monitoring program. Soil has been replaced in the yards of many residences in East Helena, and removed to ASARCO property. Three City of East Helena Public Water Supply wells are located approximately one to two miles downgradient from the apparent tip of the arsenic plume. (*City of East Helena Public Water Supply SWDAR*, Table 2 and Figure 3). Two Twilight Mobil Home Park wells are also located approximately one mile downgradient

from the plume. (*East Helena Area Public Water Supply Wells*, MDEQ map dated 5-28-02) However, none of these wells are identified or acknowledged in the Report as potential exposure routes, the well locations are not provided, the potential effects of operation of these wells on the arsenic plume are not considered, and residents are not identified as potential receptors in the Report. The *SWDAR* referenced above provides valuable regional perspective on the aquifer beneath East Helena, and details such as the estimated pumping capacity for each public well. Revise the Draft Report to identify East Helena residents as known and potential receptors of hazardous constituent releases from the facility through multiple pathways (air, soil, groundwater and surface water), and specifically reference the *SWDAR* and child lead studies. Provide details on the Public Water Supply and Twilight wells and the East Helena soil removal program.

8. The actual horizontal velocity of the "intermediate" aquifer arsenic plume has not been determined with a high degree of certainty, and the very low velocity estimated in the Report (one block in 50 years) may actually be substantially faster. The available data do not definitively or adequately confirm such a slow rate of migration in the Intermediate Aquifer. The location of the northernmost edge of the deep arsenic plume (where the 0.010 mg/L MCL is exceeded) is also indefinite. The arsenic plume is not contained, and no barriers exist between the plume and downgradient water supply wells except the adsorptive capacity of the intervening aquifer matrix. ASARCO assumes that fine-grained aquifer material will provide adequate attenuation capacity. However, the East Helena Public Water Supply (EHPWS) wells downgradient from the plume are screened over relatively short intervals, but have yields averaging nearly 600 gallons per minute. (SWDAR Table 2) This information suggests that the production intervals are coarse sand and gravel. The physical and chemical characteristics of the aquifer between the plume and the EHPWS wells (and adjacent Twilight Mobile Home Park wells) are therefore of key importance in determining the migration rate of the plume. Unfortunately, only one monitoring well, EHS-113, is located between the estimated location of the leading edge of the plume and the EHPWS wells. Revise the Report to identify adequate characterization of this portion of the aquifer (from the plume to EHPWS and Twilight wells) as a major data gap that will be addressed to adequately support risk assessment and corrective measure decisions.

9. Possible corrective measure alternatives are not discussed in the Report, except to explain in Section 6.1 that they will be addressed in the future Corrective Measures Study. Considerable effort has been expended by ASARCO to develop an air sparging and iron solution injection process to immobilize arsenic in the aquifer. Submittal of the results from these investigations was required as part of the Report, but has apparently been delayed. Only one other potential corrective measure (pump and treat) is even mentioned. Although the statement of objectives does not explicitly require theoretical development of potential corrective measures in the RFI Report, two objectives of the RFI are to support development of corrective measure alternatives, and to provide data adequately definitive to support selection of corrective measures. These objectives cannot be met if possible corrective measures are not examined in detail in the Report. For example, two possible corrective measures, in combination, may effectively minimize future migration of arsenic and other contaminants in subsurface soil and groundwater. These are: 1) paving the remainder of the site above highly contaminated deep soil (areas that are not already adequately paved or covered by buildings) to prevent infiltration, and 2) removing the main sources of groundwater flowing beneath the facility. Upper Lake and Lower Lake are described as the main sources of groundwater recharge to the shallow alluvial groundwater system in the ASARCO plant site on page 8-6 of the Report. The Report does not consider these measures, and the level of detail in the information provided in the Report is inadequate to determine the

additional area(s) that would need to be paved, or the effects of draining or isolating Upper Lake and Lower Lake (e.g., with sheet piles). Revise the Report to include consideration of additional paving or other infiltration barriers, draining or isolating Upper and Lower Lakes, the air sparging and iron injection approach, and the pump and treat alternative. Provide supporting information adequate to definitively determine the probable effectiveness of these measures, or identify additional investigations necessary to determine effectiveness.

10. The risk assessment (RA) plan in Section 7 of the Report includes many of the basic elements required for RA; however, it appears that RA goals and objectives were not considered during the data quality objective / RFI work plan phases and prior to RFI sampling, because a site-specific exposure model is not presented and required detection limits for data to be used in the RA (compared to available data) are not addressed. This may have resulted in RA data gaps and inadequate analytical detection limits. In order to verify that there are no RA data gaps and that the detection limits for available data were adequate, the following tasks must be completed:

    - Construct human and ecological site conceptual exposure models (SCEMs) and evaluate the impact of these SCEMs on the RFI data (i.e., impact on sample media, sampling locations, and sampling depths). Figure 5-1-1 should be split into two separate human and ecological SCEMs and specific exposure points (e.g., Prickly Pear Creek and East Helena water supply wells) and receptors (e.g., recreational fishermen, benthic macroinvertebrates, residential water consumers, etc.) should be added. These SCEMs should then be used to identify potential RA data gaps.

    - Identify appropriate human and ecological risk data quality levels (DQLs) and compare these risk DQLs to the RFI sample detection limits. (If historical RI data are to be used in the RA, those detection limits must also be evaluated.) Examples of human and ecological DQLs include EPA Region 9 Preliminary Remediation Goals and EPA Region 5 Ecological Data Quality Levels, respectively. Nondetections with detection limits above risk DQLs should not be eliminated from the RA.

11. The RA plan should be revised such that the evaluation of ecological risk is in accordance with EPA's 1997 *Ecological Risk Assessment Guidance for Superfund* (ERAGS). Specifically, the plan should discuss steps 1 and 2 in ERAGS that comprise a Screening Level Ecological Risk Assessment (SLERA). The components of a SLERA to be presented in the revised plan should include, but not necessarily be limited to:

    - Screening level problem formulation and ecological effects characterization
        - -- Description of general ecological setting (Appendix A of the 1997 ERAGS has an ecological checklist to be completed by the field biologist)
        - -- Identification of receptor species likely affected
        - - Construction of ecological SCEM
        - - Selection of screening ecotoxicity values / benchmarks
        - - Identification of preliminary contaminants of potential ecological concern (COPEC)

    - Screening level exposure estimate and risk calculation

- Scientific management decision point indicating negligible ecological risk or continuation to a baseline ecological risk assessment

Additional guidance on the performance of SLERAs is located in ECO Update Number 12: *The Role of Screening -Level Risk Assessments and Refining Contaminants of Concern in Baseline Risk Assessments* (EPA 540/F-01/014, 2001) and ECO Update Number 13: *Ecological Risk Assessment at Superfund and RCRA Corrective Action Sites* (February 2001).

12. The RA plan should be revised to discuss the methods that will be used to determine background concentrations in the various environmental media of concern and how these background concentrations will be used in the RA. Guidance on the determination and use of background includes EPA's *Guidance for Characterizing Background Chemicals in Soil at Superfund Sites* (OSWER Directive 9285.7-41, 2001), *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (1989 and 1992 addendum) and *Role of Background in CERCLA Cleanup Program* (OSWER Directive 9285.6-07P, 2002).

13. The database of water analyses is not consistent among the Appendices, text references, and figure citations. Many of the figures present data that are not up to date. For example, zinc concentrations in shallow groundwater are plotted in Figure 4-3-11. None of the wells in East Helena are shown to have concentrations above the detection limit of 0.02 mg/L. However, the most recent sampling round in the Fall of 2002 resulted in at least 5 detects ranging in concentration from 0.115 (EH-60) to 0.98 mg/L (EH-109). These recent data indicate that zinc is moving offsite into East Helena. More importantly, the arsenic concentration in EH-111 at the leading edge of the plume in the Intermediate Aquifer shown as 0.026 mg/L on Figure 4-3-19. However, data in Appendix 3 (not discussed in the text) show a range of 0.32 to 0.82 mg/L for samples taken from this well in the Fall of 2002. This variation in concentration (greater than an order of magnitude) must be addressed in Sections 4.3.3 and 8.3. In addition, no concentration is provided on Figure 4-3-19 for EH-114. The data on all figures should be checked and revised as necessary to ensure that they are up to date and accurately described in the text.

14. Text references to constituent concentrations are confusing. For example, on page 4-43, reference is made to arsenic concentrations in samples from wells in East Helena. The following concentrations are cited: EH-109 (8.45 mg/L), EH-100 (3.91 mg/L) and EH-106 (3.86 mg/L). On Figure 4-3-19, the following concentrations are cited: EH-109 (10 mg/L), EH-100 (7.7 mg/L) and EH-106 (6 mg/L). The differences in these values must be explained. This is only one of a number of similar inconsistencies noted in the Report. The text, appendices, and figures need to be made consistent. Otherwise, the logic is very difficult or impossible to follow.

15. A small number of the RFI data validation reports (DVRs) were examined for compliance with EPA standards. No apparent discrepancies were found in the reports reviewed. However, only half of the DVRs provided in Appendix 3 are listed in the index for the appendix, and DVRs for the RFI data in Appendix 7 (Subsurface Soil) are missing. Provide an accurate index for the DVRs in Appendix 3 and the missing DVRs in Appendix 7.

SPECIFIC COMMENTS

1.2.3 Groundwater (pages 1-7 to 1-10)

1. Section 1.2.3 provides background information on the groundwater system at the ASARCO facility based on the results of previous investigations. Five hydrostratigraphic units are defined, including the perched aquifer, Upper Aquifer, Intermediate Aquifer, ash/clay unit, and deep aquifer. The Upper and Intermediate Aquifers, as defined in the RFI, refer to the upper and lower portions of the saturated unconsolidated unit, respectively. According to Page 1-8, these units are typically, but not always, separated by thin clay or silt layers. According to common practice in defining hydrostratigraphic units, a hydrostratigraphic unit generally consists of adjacent geologic formations, or parts of formations, with similar hydraulic conductivities, and thus with similar abilities to transmit groundwater. However, the description presented in Section 1.2.3 does not clearly indicate the basis for the designation of hydrostratigraphic units. The section should be revised to indicate whether previous investigations determined that the Upper and Intermediate Aquifers were distinct hydrostratigraphic units, and therefore possess significant differences in hydraulic conductivity, or if these aquifers were distinguished based on other criteria such as relative depth in the unconsolidated unit or the occurrence of discontinuous silt/clay layers. Descriptions of the five hydrostratigraphic units is repeated throughout the RFI. Any revisions should be reflected in all descriptions of hydrostratigraphic units at the ASARCO facility. This information is needed to provide the framework for understanding the dynamics of groundwater flow.

2. The Report states (page 1-9) that arsenic is not elevated in the Deep Aquifer beneath the ASARCO facility site or the City of East Helena. Revise the Report to present the Deep Aquifer wells and data to support this statement.

2.1.2 Former Upper Ore Storage Area and Area Between Upper and Lower Lake Surface Soils (page 2-4)

3. Twenty new locations and five "existing" locations were sampled to characterize the Former Upper Ore Storage Area and the area between Upper and Lower Lakes. Surface soil samples from the five existing locations, SS-1, SS-2, SS-3, SS-4, and SS-24 were collected in 1987. In addition to potential accumulation of releases during the remaining years of operation of the facility, several soil removal activities occurred in these areas. The Report does not explain where soils were excavated in these areas, but it appears to be possible that the former or "existing" sample locations were removed. If soil has been removed at these SS sample locations, the data cannot be used to characterize current conditions at the Facility. Provide descriptions of the soil removal zones in these areas, and explain whether soil at the "existing" 1987 sample locations has been removed.

4. Surface soil samples SS-1 through SS-4, and SS-24 were all sampled from 0 to 1 inch. The UOS-SS1 through UOS-SS20 locations were all sampled from depths of 0-4 inches and deeper. Data from 0-4 inches depth samples may contain lower average concentrations than the 0 to 1 inch samples. Revise the Report to explain whether the differences in concentrations reported for the two types of samples has been evaluated, and whether the different depth ranges result in significantly different reported metal concentrations.

2.13 Rail Corridor Areas (page 2-5)

5. The Report discusses collecting transect samples perpendicular to the rail line consisting of three to five sample locations. It is unclear if the transect samples were combined into composite samples or if the samples were individually analyzed, although separate sample data are shown in Appendix 7 and Exhibit 3. Revise the text to clarify how the samples were collected and analyzed.

2.1.5.3 Area East of Plant Site (page 2-7)

6. Three locations were sampled in the area east of the plant site and data from two previous sampling locations, DH-11 and DH-7 (1987) were combined with RFI samples to meet the minimum four surface soil samples required. Although this sampling format was approved in the RFI Work Plan, the old data may not accurately describe current soil contamination. Table 1 lists surface soil data from samples collected in the area east of the plant site. Comparison of the data from the two time periods suggests apparent increases in all of the reported metals during the 14 years between sampling activities in this area. In addition to smelter releases, the area east of the plant is apparently used to manage soil removed from East Helena yards, although this is not mentioned in the Report. Provide a description of the area used for managing soil removed from East Helena, and explain whether any of the samples in Table 1 were located in or adjacent to that area.

   The data in Table 1 were obtained during the Report review, from the database in Appendix 7. The 1987 data provided in Table 2-1-1 in the Report contain an apparent error for the lead concentration in sample DH-7, which is given as 689 instead of 889. Revise the Report to correct this error.

Table 1: Surface Soil Sampling Data for the Area East of Plant Site

Sample Location	Date	As	Cd	Cu	Pb	Zn
DH-7	1987	99	17	288	889	518
DH-11	1987	131	37	263	847	923
UOP-SS19	2001	145	80	415	2,706	2,585
UOP-SS20	2001	101	28	200	1,094	946
UOP-SS21	2001	387	79	500	3,811	1,816

2.3 Surface Soil Analytical Results (page 2-9)

7. Soil samples UPS-SS1 through UPS-SS14 were not analyzed for mercury, thallium, selenium and silver (all are hazardous constituents) found at elevated concentrations in previous surface samples, including SS-28, SS-1 and SS-2. Mercury was reported in these samples at 360 ug/g, 240 ug/g, and 236 ug/g respectively. These three 1987 samples are used in the Report to characterize the current on-site soil contamination, but only for arsenic, lead and cadmium, and

other elements that are not hazardous constituents. Continued operation of the facility for 14 years after these samples were collected may have resulted in increased concentrations of hazardous constituents at these sample locations. Adequate characterization of surface soils within the facility requires samples collected after the smelter closed in 2001. At least a representative group of surface soil samples should be analyzed for mercury, thallium, selenium and silver, as well as the other hazardous constituents released at the facility. The absence of recent analyses for all released hazardous constituents should be identified as a remaining data gap.

8. The second paragraph, second sentence states: "Of the metals analyzed, arsenic, cadmium, copper, lead and zinc had the highest concentrations." This sentence is misleading because arsenic, cadmium, copper, lead and zinc were the only metals determined. The discussion does not address other hazardous constituents that are present at elevated concentrations in the soil. Revise this sentence to accurately reflect the actual analytes, and explain the rationale for excluding mercury, thallium, selenium and silver.

9. The second paragraph, last sentence states, "The lowest concentrations were from samples collected in soils adjacent to the ASARCO plant site." This statement contradicts the preceding sentence, which acknowledges "high concentrations of arsenic and metals" in profile samples from the railroad track corridors (and Upper Ore Storage Area). Samples from the rail car staging area located adjacent to the ASARCO plant site indicated high levels of lead, cadmium, and arsenic. Data in Table 2-3-1 indicate that the rail car staging area had the highest level of copper in the 0-4 inch depth. Surface arsenic concentrations in the rail car staging area (RCSA-series) samples shown on Exhibit 3 are comparable to concentrations within the facility ore storage and processing areas. Revise this statement to acknowledge the high metal concentrations in the rail car staging area.

3.1.1 Prickly Pear Creek, Upper Lake and Lower Lake (page 3-1)

10. The second paragraph states that "Water quality data are also collected from Upper Lake and Lower Lake" as part of the Post RI monitoring. However, the last two sentences in the following paragraph (page 3-2) indicate without explanation that no samples have been collected from Upper Lake since 1990. Due to continued operation of the facility until 2001, and extensive cleanup activity between Upper and Lower Lakes since 1990 (not described in the Report), significant changes in water quality may have occurred. The quality of water in Upper Lake may be highly significant because it is identified as one of the main sources of recharge to the shallow aquifer beneath the facility, in Section 8.3.2 of the Report (page 8-6). Upper Lake is also likely to be directly affected by any upstream hazardous constituent release sources (asserted to exist in Section 3.3.1.3). Provide the rationale for not sampling Upper Lake, provide more recent data, or identify the lack of Upper Lake analyses since 1990 as a remaining data gap.

3.1.3 Standing Water Sampling (page 3-3)

11. This section lacks a description of how and when the standing water locations were sampled. For example, the Report does not explain if samples were collected from ponds that developed after a rain storm, or if water was applied to the sampling areas via water truck and then sampled. Revise the section to include descriptions of the sampling circumstances.

3.3.1.2 Prickly Pear Creek Water Quality (page 3-11 and 3-12)

12. The second paragraph of page 3-11 refers to Table 3-3-2, which incorrectly identifies the Federal MCL for arsenic as 0.05 mg/L, and the 0.010 mg/L level (in footnote 3) as the "recommended revised" MCL for arsenic. The arsenic value of 0.010 mg/L was clarified and confirmed in the US EPA Federal Register notice dated March 23, 2003. Revise Table 3-3-2 to remove the 0.05 mg/L value and provide an accurate reference for the current final arsenic MCL.

13. This section discusses the concentrations of arsenic and metals, but mercury and thallium are not included. Mercury has been detected in Prickly Pear Creek, although historical analytical techniques were barely adequate to detect mercury at concentrations of concern. Many mercury data between 1984 and 1996 were reported as equal to or slightly above detection limits. One filtered sample collected at PPC-6 in 1985 exceeded the current MCL of 10 ug/L, and total mercury was 46 ug/L. An off-site runoff sample collected in 1985 at Site D, 0.3 mile east of the plant site, was reported to contain 107 ug/L total mercury. Thallium was detected in a filtered sample from PPC-4 above the current Region 9 PRG of 2.4 ug/L, and total thallium was 6 ug/L. Revise this section to include discussion of historical mercury and thallium data, including these apparently isolated peak values. Provide the rationale for not including any analyses for these hazardous constituents in the RFI to characterize the current status of surface water in Prickly Pear Creek or identify comprehensive hazardous constituent analyses as a remaining data gap.

3.3.1.3 Prickly Pear Creek and Upper Lake Sediment Quality (pages 3-14 and 3-15)

14. All data used in the Report to characterize the sediment of Prickly Pear Creek are from 1984 and 1985. No more recent sediment samples were collected for the RFI. Erosion and transport of contaminated on-site dust and soil, and continued operation of the facility for 16 years after the last sample, may have resulted in continued accumulation of metals in the sediment. Provide the rationale for using only 1985 data to characterize current conditions or identify the lack of recent sediment analyses as a remaining data gap.

15. One of the objectives of the RFI is to identify actual and potential receptors. The RFI does not discuss the actual and/or potential aquatic life, wild and domestic mammals, and human receptors that may come into direct contact with Prickly Pear Creek sediment. For example, the Creek flows through East Helena, where many school-age children and pets reside. Revise this section to include identification of actual and potential receptors.

16. The first bullet on page 3-15 states that "As noted in the CERCLA Comprehensive RI/FS, historical mining impacts are well documented and are a major source of arsenic and metals to Prickly Pear Creek." No data supporting this assertion are provided or referenced. This type of vague reference cannot be accepted as definitive or adequate characterization. Revise the Report to provide data supporting the claim that sources other than the ASARCO facility are major contributors of arsenic and metals to Prickly Pear Creek.

4.1.3 Aquifer Testing (page 4-3)

17. The RFI (Page 4-4) states that the pump test data "were analyzed using the methods of Theis (1935) and Cooper and Jacob (1946) or by Newman (1972) if drawdown was affected by delayed yield" and that the "Bower and Rice (1976) method" was used for evaluating slug test data from unconfined aquifers. The methods used to evaluate pump test and slug test data are summarized

in Table 4-1-3. However, there are discrepancies between the methods presented on Page 4-4 and the methods listed in Table 4-1-3. For example, Table 4-1-3 indicates that not all slug tests were evaluated using the Bower and Rice method (e.g. DH-3) and the Neuman method is not listed in the table. The description presented on Page 4-4 and Table 4-1-3 should be revised for consistency.

4.3.1 Hydrostratigraphic Units (page 4-12)

18. Section 4.3.1 provides an expanded discussion of hydrostratigraphic units presented in Section 1.2.3 based on Interim Measure (IM) and RFI investigation results. The section discusses the extent of the perched groundwater (page 4-14), the clay/silt layer between the Upper and Intermediate Aquifers (page 4-15), and the ash/clay unit (page 4-15). The section references updated cross sections provided in Exhibits 5, 6, and 7 to illustrate the stratigraphic relationships between the five hydrostratigraphic units and the discussion of the ash/clay unit references the "structural contour map of the Ash/Clay Unit" presented as Figure 1-2-3. However, the section contains an inconsistency regarding stratigraphy. On page 4-13, it states that "the Intermediate Aquifer is typically (but not always) separated from the Upper Aquifer by a thin (1 to 3 feet) fine-grained clay or silt layer," but on page 4-15 the text states that these aquifers "are sometimes separated by thin (2 to 9 feet) clay and silt lenses." This inconsistency is not easily resolved through review of the cross sections. In addition, it is often difficult to visualize the lateral extent and thickness of important features based on the cross sections. Therefore, additional plan view maps are required to illustrate the occurrence of the perched groundwater and the position and thickness of the discontinuous clay/silt layer between the Upper and Intermediate Aquifers. Three additional plan view maps are required: 1) the lateral extent of the area where perched groundwater conditions were observed 2) elevation contour map of the top of the clay/silt layer that separates the Upper and Intermediate Aquifers (clearly indicating areas where the layer is absent), and 3) an isopach map of the thickness of the clay/silt layer that separates the Upper and Intermediate Aquifers. These maps are critical to understanding groundwater flow at the site and should be used to describe the site stratigraphy.

19. The Report describes (page 4-12) the Upper Aquifer as "an unconfined or partially confined shallow groundwater system." However, the occurrence of partially confined zones is not documented or discussed further. In addition, no discussion of aquifer type [unconfined or partially (semi) confined] for the Intermediate Aquifer is presented. Aquifer type affects method selection for aquifer and slug test analysis and definition of layers in the groundwater model; therefore, the RFI should be revised to more clearly describe aquifer type.

4.3.2.1 Aquifer Permeability (page 4-16)

20. Section 4.3.2.1 discusses hydraulic conductivity results obtained from slug and aquifer tests. Table 4-1-3 provides minimum, maximum, and mean hydraulic conductivity values for Upper and Intermediate Aquifers. A review of the data indicates similar values of hydraulic conductivity for areas where both units are present, which has important implications for groundwater movement between the two units and relates to whether these units are true hydrostratigrahic units, as discussed in Specific Comment 1. However, Section 4.3.2.1 does not include a discussion of hydraulic conductivity between the Upper and Intermediate Aquifers, and should be revised.

4.3.2.3 Groundwater Flow Directions (pages 4-20 to 4-22)

21. Table 4-3-3 presents water level differences at paired groundwater monitoring well sites. The table, referenced on page 4-22, is used to discuss vertical gradients within the upper, intermediate, and deep aquifers. However, both the table and the discussion in Section 4.3.2.3 require revision to more accurately characterize groundwater flow:

    - Table 4-3-3 presents the difference in observed head, but does not calculate hydraulic gradient. The magnitude of hydraulic gradient, and not head difference, drives vertical flow. Therefore, the table should be revised to include a calculation for average hydraulic gradient. Footnotes should also be added to Table 4-3-3 to document the data used in the calculation.

    - Page 4-22 references head differences to discuss vertical flow, which as discussed above is inappropriate. The discussion also overemphasizes the well pairs with upward gradients. The data in Table 4-3-3 indicate upward gradients between only 3 of 10 well pairs. In East Helena, only two of the five well pairs reported upward gradients. A more balanced discussion of results is appropriate. The section should be revised to present the magnitudes of hydraulic gradients, with reference to ones that are near neutral. These results should also be discussed in terms of the conceptual model for groundwater flow and vertical hydraulic connection.

4.3.3.1 Inorganic Constituents (pages 4-25 to 4-46)

22. Section 4.3.3.1 discusses inorganic concentrations in the upgradient wells, ASARCO Plant Site, East ASARCO Plant Site, West ASARCO Plant Site, and downgradient wells. The section references analytical results (Appendix 3), water quality statistics (Appendix 5), and time series plots of select water quality parameters (Appendix 4). Although these statistics and graphical illustrations are useful in assessing water quality trends, it is clear that additional analysis is needed to identify and interpret water type and to clarify the site conceptual model. For example, on page 4-29, regarding the ASARCO Plant Site wells, the Report states that "groundwater quality in these monitoring wells have historically appeared similar to Lower Lake water quality." On page 4-28, regarding the East ASARCO Plant Site wells, the Report states that "in general, water quality in these monitoring wells looks similar to well water quality both up and down gradient of the slag pile and shows the same general pattern of water quality impacts from Lower Lake." However, these generalized comments do not reference supportive data or analyses. Analyses of water types will also provide input on other issues relating to the site conceptual model, such as the mixing relationships between groundwater and Wilson Ditch and Prickly Pear Creek or between the upper, intermediate, and deep aquifers. Revise the Report to provide trilinear diagrams using major anion and cation concentrations from the upper, intermediate, and deep aquifers and surface water bodies. The results should be used in support of the site conceptual model where appropriate in the RFI.

23. The Report states (page 4-27) that two groundwater monitoring wells (DH-2 and DH-3) were installed to characterize upgradient groundwater conditions. Summary statistics for selected parameters are presented in Table 4-3-5 (incorrectly referenced as Table 4-3-6 on page 4-28). Table 4-3-5 includes data from wells DH-1, DH-2, and DH-3. Well DH-1 is not mentioned in the discussion, and review of the Exhibit 1 confirms that well DH-1 is not hydraulically upgradient

of the facility. Table 4-3-5 should be revised to include data from wells DH-2 and DH-3 and the discussion on pages 4-27 and 4-28 should be revised to reflect the necessary changes to the table.

24. The first bullet on page 4-27 includes the "...proposed drinking water MCL for arsenic (0.015)." [mg/L] This statement is incorrect in two ways: The federal MCL for arsenic is 0.010 mg/L, although it will not be enforced until January 23, 2006. The arsenic standard is not in "proposed" status, and the enforceable value of 0.010 mg/L was clarified in the US EPA Federal Register notice dated March 23, 2003. Revise the statement to acknowledge the current final MCL value.

25. The Report discusses upgradient groundwater quality, including the relatively low concentrations of arsenic found in upgradient wells. The discussion states (page 4-27, last paragraph) that "...groundwater from wells DH-2 and DH-3 are not influenced by ASARCO plant site activities." This statement does not acknowledge the widespread distribution of arsenic and other hazardous constituents documented in the Phase I and Phase II RI Reports. Arsenic and numerous other contaminants released from the ASARCO facility are present at elevated concentrations (high above background levels) in soil for long distances to the south, upgradient from the locations of wells DH-2 and DH-3. Therefore, although these wells are definitely upgradient from the facility, they cannot be accepted as "not influenced by ASARCO plant site activities." Revise the statement to acknowledge the locations of the upgradient wells within the area impacted by releases from the ASARCO facility.

26. The fact that decreases in arsenic concentrations in waters from many site wells are accompanied by similar decreases in sulfate and chloride concentrations (page 4-34) indicates that the arsenic decreases are not simply due to adsorption by aquifer materials. Sulfate and chloride are not sorbed significantly by aquifer materials. This observation implies that observed decreases in arsenic concentrations must be balanced by increases in arsenic concentrations in other parts of the flow system that are not sampled at present. Revise this section of the Report to consider apparently simultaneous decreases in sulfate and chloride concentrations along with arsenic concentration decreases.

27. The argument (page 4-36) that spikes in the concentrations of contaminants in an upgradient well that do not to appear in downgradient wells is evidence that contaminants are being precipitated is rather weak. The figures on which the data for this argument are plotted are so cluttered they make the argument very difficult to follow. Revise the Report to clarify the evidence supporting the precipitation discussion.

28. Figure 4-3-2 does not contain As III data referred to in the text (page 4-36). Revise the Report to provide an accurate reference.

29. Page 4-37 contains the following statement: "down-gradient sulfate locations have shown an increasing trend beginning in 2001 and may reflect operational changes associated with plant operational suspension in April 2001." Revise the Report to explain how closure of the plant might cause increases in groundwater sulfate concentrations.

30. The Report suggests (page 4-39) that there is a consistent relationship between decreasing arsenic concentrations and increasing iron and manganese concentrations. This conclusion is not supported by the data plotted in Figure 4-3-15. Revise the Report to reflect the referenced data.

31. The text refers (page 4-45) to the arsenic concentrations in well EH-100 that have increased from 0.051 mg/L in 1988 to near 7.0 mg/L in 2002. However, no samples were analyzed from this well between April 1988 and November 2001. Thus, the arsenic concentration may have increased regularly in this well over the 13-year time gap. Note that arsenic concentrations increased regularly in nearby well EH-60 over this time interval (Figure 4-3-18). The text cites recent increases in arsenic concentrations in well EH-50 (paired with EH-100) as evidence that the increases in arsenic concentrations in well EH-100 may also be recent. However, the arsenic concentration data presented for samples from well EH-50 in Appendix 3 show only small increases in recent samples (0.072 mg/L in 1999 to 0.12 mg/L in 2002). The most likely explanation for the arsenic plume in the Intermediate Aquifer beneath East Helena is that it represents transport from the plant site along high flow/high permeability zones in the Intermediate Aquifer. Revise the Report to give this alternative serious consideration.

4.3.4.1 Total Metal Concentrations (page 4-52)

32. The first sentence of the first paragraph states "Total metal concentration summary statistics for subsurface soil samples are in Table 4-3-16 through Table 4-3-17," but the sample data are actually in Tables 4-3-15 and 4-3-16. This error is repeated throughout the section. Revise the Report to correctly identify the tables.

33. In paragraph four, the area along the plant site northern boundary is identified as the area of lowest metal concentrations in unsaturated subsurface soil. Data in Exhibit 3 indicate that the area along and beyond the northwestern boundary of the plant site has areas of high arsenic concentrations, especially at the RCSA sampling locations. RCSA data in Appendix 7 include numerous high concentrations of arsenic, cadmium and lead. Revise this discussion to accurately identify the areas of high concentration along the northern plant boundary and the rail corridor.

5.2 Environmental Chemistry (pages 5-4 to 5-9)

34. Numerous references are given in the sections on environmental chemistry that are not in the reference list (e.g., Callahan, 1979; Baes and Mesmer, 1976; Long and Angino, 1977; etc.). Revise the Report to provide the missing references for these and other citations.

35. The Report states (page 5-7) that cadmium exists in the +2 oxidation state in the natural aqueous environment, without supporting data or references. Revise the Report to provide supporting data or references for this information and similar information cited in other sections.

5.4.1.5 Hydraulic Parameters (page 5-21)

36. The Report states (page 5-21) that hydraulic conductivity values were initially assigned to areas of the model based on aquifer test data and that subsequently these K values were refined during model calibration. On page 5-22, the Report states that assigned K values are shown in Figure 5-4-6. However, the Report provides no presentation or discussion of calibrated hydraulic conductivity values. The section should be revised to include a figure that illustrates the calibrated values. In addition, a table should be included comparing calibrated values with summary statistics (i.e., minimum, maximum, mean, standard deviation) for aquifer test results within each area of the model. This section should reference the comparison table and discuss whether calibrated hydraulic conductivity values were within the range of measured values. This discussion should also be referenced in Section 5.4.2 (Model Calibration).

37. The Report states (page 5-22) that "model cells were assigned a uniform specific yield of 0.25 and a specific storage of 0.00001." This statement implies that both unconfined and confined conditions were specified in the model. This section should be revised to include additional detail and justification regarding model layer designations.

5.4.3.2 Effects of Residual Arsenic in Shallow ASARCO Plant Site Soils (page 5-28 and 5-29)

38. The Report discusses ASARCO plant soil evaluations using leachability test data. The conclusion of this evaluation is that soil leaching may increase arsenic concentrations in groundwater beneath the plant site by 0.01 to 0.5 mg/L in areas historically effected by contaminant releases (e.g., Speiss area, acid plant, soil storage areas). Soil leaching is therefore not considered a significant future source of contamination, especially if infiltration is cut to zero in the contaminated areas. The difficulty with this reasoning is that 0.5 mg/L is 50 times the MCL for arsenic. Dispersion and dilution may reduce concentrations downgradient from the soil leaching zone(s), but the evidence suggests dispersion and dilution are not dominant processes in controlling arsenic concentration in groundwater at the site. For example, the deep arsenic plume from the facility is narrow and the high concentrations at the center of the plume remain at similar values over long distances. Thus, subsurface soils have the potential to be significant sources of arsenic above the MCL in downgradient groundwater for many years to come. If there is no infiltration at the contaminated areas (additional paving or other cover construction may be required), the effect of these potential sources will be minor. However, if the surface barriers to infiltration degrade with time, or are removed, subsurface soils could again become active hazardous constituent release sources. Revise the Report to discuss these factors and their effects on transport conclusions.

5.4.5 Model Conclusions (pages 5-30 and 5-31)

39. The arsenic transport model developed for the RFI predicts that arsenic transport rates will be very slow in the next 50 years, on the order of one city block. The text also states that this estimate is probably conservative mainly because arsenic is not reversibly bound on aquifer materials based on leach tests performed in the RFI. These conclusions are likely too optimistic for three main reasons:

- The leach tests referred to above involved samples from the plant site, not samples from wells drilled in East Helena. Samples from the plant site may contain arsenic that is not readily leached, whereas arsenic sorption reactions on materials from an uncontaminated aquifer (below East Helena) are likely closer to being reversible.

- The arsenic transport distance predicted for the next 50 years is based on average values for flow and transport parameters. However, the narrowness of the arsenic plume beneath East Helena strongly suggests the existence of a preferential pathway (e.g., gravel) that may have hydraulic conductivity much higher than an average value.

- The Report argues or implies (page 4-41, para. 3; page 55, para 2) that fine-grained (low-permeability) sediments occur at the frontal edge of the arsenic plume in East Helena and are slowing the movement of the plume. However, western East Helena well logs indicate the alluvial section contains ubiquitous gravelly or sandy gravel layers. The heterogeneity of the alluvial section will most likely provide preferential flow paths for contaminant transport in East Helena as well as other parts of the flow system.

Therefore, longitudinal dispersivity is likely to be higher than the values used in the transport models.

Revise the Report to address the effects of the above factors on the arsenic transport conclusions.

7.0 Phase II RFI- Risk Assessment (page 7-1)

40. A reference to EPA's seminal ecological risk assessment guidance, i.e., 1997 ERAGS, should be added.

7.1.1 Development of a Conceptual Site Model (pages 7-2 to 7-4)

41. A reference to EPA's 1992 *Guidance for Data Useability in Risk Assessment* should be added to the third bullet.

42. The first bullet in the second half of page 7-3 states that onsite risks to workers from soil exposure are managed by an ongoing OSHA health and safety program. It should be noted that, although current worker exposures are controlled, risk evaluations in a baseline RA are conducted in the absence of such behavior-dependent controls in order to determine baseline risks and the need to maintain current worker protection or institute new worker protections or engineering controls. In addition, baseline RAs evaluate not only current risks, but also potential future, uncontrolled risks. The apparent absence of future operating plans for the facility suggests that OSHA-type controls may not be adequate to mitigate typical future exposures.

43. The first bullet on page 7-4 should be amended to include a statement that nonpotable residential exposures to groundwater (i.e., lawn watering, car washing, water play, etc.) are possible and will be evaluated in the RA. These exposures would include dermal contact and incidental ingestion of groundwater during nonpotable uses of well water.

7.1.2 Evaluation of Human Health Risks (page 7-4)

44. At the end of the sentence: "A quantitative estimate of exposure will be provided for each complete exposure pathway" include the following reference: "using appropriate exposure factors published in EPA's 1991 *Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors* (OSWER Directive 9285.6-03) and 1997 *Exposure Factors Handbook.*"

7.1.3 Evaluation of Ecological Risk (page 7-5)

45. This section should be revised to include the basic components of a SLERA according to EPA's 1997 ERAGS (see General Comment 11). In addition, this section should discuss the methodology for selecting ecological risk screening criteria. Accordingly, the revised section should present a tiered hierarchy of 3 to 4 ecological screening criteria sources, justify the use of these sources, and then state that this hierarchy will be applied consistently to all analytical results. Examples of ecological criteria for sediment and surface water include the following in order of decreasing utility:

Sediment

- MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000. *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems*. Archives of Environmental Contamination and Toxicology 39: 20-31.

- Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and J. Field. 1996. *A preliminary evaluation of sediment quality assessment values for freshwater ecosystems*. Journal of Great Lakes Research 22:624-638

- Persaud, D., R. Jaagumagi, and A. Hayton. 1993. *Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario*. Water Resources Branch, Ontario Ministry of the Environment. Toronto

- Long, E.R., and L.G. Morgan. 1991. *The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program*. NOAA Technical Memorandum NOS OMA 52, National Oceanic and Atmospheric Administration. Seattle, WA.

Surface Water

- National Ambient Water Quality Criteria (EPA-822-R-02-047, 11/2002)

- Suter, G. W. II and C. L. Tsao. 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*, ES/ER/RM-96/R2, Oak Ridge National Laboratory, Oak Ridge, Tennessee. (Secondary Chronic Values).

- U.S. Environmental Protection Agency (EPA). 1992. *Great Lakes Water Quality Initiative Tier II Water Quality Values for Protection of Aquatic Life in Ambient Water: Support Documents*. November 23, 1992.

7.1.4 Risk-Based Cleanup Levels (page 7-5)

46. EPA's 1991 guidance *RAGS, Part B: Development of Risk-Based Preliminary Remediation Goals*, while presenting a good general outline for the calculation of cleanup goals, does not incorporate important recent developments in exposure assessment into its risk assessment calculations. These recent developments include EPA's 2002 *Risk Assessment Guidance for Superfund, Part E: Supplemental Guidance for Dermal Risk Assessment* and *Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils* (September 2002). Include a reference to the Part E RA Guidance in this section.

8.3.3 Groundwater Quality (pages 8-6 to 8-8)

47. The Report states (page 8-7) that recent data suggest "the elevated arsenic concentration plume in the intermediate aquifer in the City of East Helena is a recent phenomenon." However, RFI and historic RI data indicate that historic migration of arsenic in the Intermediate Aquifer is likely. For example, EH-100 arsenic trend data provided in CC/RA Appendix 4-3-1 suggest that the leading edge of the deep arsenic plume may have arrived at EH-100 in 1988, since the

concentration was increasing rapidly in the last two samples (late 1987 and early 1988). East Helena well EH-60 also shows a strongly increasing arsenic concentration trend since 1988 in Figure 4-3-18. (EH-60 is a relatively shallow well, but is located near the center of the "intermediate" aquifer plume shown in Figure 4-3-19.) RFI results indicate that there is no geologic boundary that would prevent the historic migration of arsenic from the Upper Aquifer to the Intermediate Aquifer. A clay/silt layer separates portions of the two saturated units, but the unit is discontinuous and thin where present. RFI results also indicate that there is hydraulic connection between the two designated units. Hydraulic gradients are near neutral in some cases and not consistently upward or downward, which indicates a complex flow system where vertical migration through diffusion and dispersion is likely. Results of aquifer and slug testing indicate similar ranges of hydraulic conductivity between the Upper and Intermediate Aquifers, which provides an avenue for vertical downward migration of arsenic. Based on these results, it is apparent that the conceptual model for groundwater flow at the site supports the historic migration of arsenic and suggests that the current plume configuration is not a recent phenomenon. The conclusion in Section 8.3.3 that arsenic migration is a recent phenomenon, and the three proposed explanations or causes, are not supported by RFI or RI data. The most logical explanation for finding increased concentrations of arsenic in the Intermediate Aquifer (i.e., that arsenic transport in the Intermediate Aquifer in East Helena was not adequately characterized until the new EH wells were constructed in 2002) is not considered. Revise this section of the Report to remove the "recent phenomenon" conclusion and proposed explanations, and provide discussion of the increasing arsenic concentrations since 1987 in samples from EH-100, EH-60 and other wells as appropriate.

48. The assertion (page 8-8) that wells installed on the facility by EPA "have provided a more complete pathway for vertical migration of contaminants resulting in poorer down-gradient water quality and elevated arsenic concentrations in the intermediate aquifer" is not supported by presentation of or reference to specific data. The locations and construction details of the EPA wells are not provided. The two "Permeable Barrier Test Well" drilling and construction logs in Appendix 6 indicate that the wells were constructed by Hydrometrics (not an EPA contractor), the screened intervals are not excessive (14 and 22 feet), and bentonite grout was used to seal the annuli. Perhaps the Report is referring to different wells. The fact that gradients in the Intermediate Aquifer are different at various locations in East Helena is not considered (page 4-22; para. 2). The asserted "primary trend of increasingly poor water quality" in the Intermediate Aquifer apparently refers to high concentration data from new wells installed in East Helena. No data are available from the new wells before 2002, and no other increasing concentrations in Intermediate Aquifer wells are referenced. Increasing arsenic concentration trends have been identified in intermediate well EH-100 and near-intermediate well EH-60, and the data from those wells should be discussed in this section of the Report. Finally, if the suggested "sudden rapid migration" theory is correct, it dramatically demonstrates the error of the conclusions in Section 5.4.5 (that the arsenic plume will move one block in 50 years). If the statement concerning EPA wells is not removed from the Report, an expanded analysis should be provided to explain and support the suggested relationship between EPA wells and Intermediate Aquifer arsenic concentration increases.

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Data Verification Report

I. Introduction

This report provides the results of an independent technical review performed during May 2003 by Booz Allen Hamilton (Booz Allen) of data validation reports prepared by Hydrometrics, Inc. on behalf of the ASARCO Inc. East Helena Facility in East Helena, Montana. At the direction of EPA Region 8, this review was performed as a data verification activity on select samples that spanned ASARCO reports from 1999 through 2002. Specific data were selected for verification by Booz Allen based on informal assessment of the importance of the original data to the RFI conclusions, and examination of a wide variety of types of data.

The samples specifically selected for data verification are listed in the table below.

Report	Matrix	Analysis
Monitoring Well Drill Hole Soil Samples November and December 1999, XRF Data	Soil	Inorganics
Soil Data For 2001	Soil	Inorganics
Surface Water and Groundwater Semi-Annual Monitoring October-November 2002	Aqueous	Organics/ Inorganics
Discrete Measurement Level Water Samples December 2002	Aqueous	Inorganics
New Well Samples October 2002	Aqueous	Inorganics

Data verification was performed to verify compliance with the U.S. EPA (USEPA) Contract Laboratory Program National Functional Guidelines for Organic Data Review (1999), U.S. EPA Contract Laboratory Program National Functional Guideline for Inorganic Data Review (February, 1994 and July, 2002) and the specific validation criteria outlined in the "RCRA Facility Investigation Quality Assurance Project Plan East Helena, Volume III, RCRA Facility Investigation Work Plan, Final, December 2000." Because the raw data were not provided, no

further judgement on data quality was made. Specifically, the following tasks were performed for the data verification:

- Verification of compliance with the project-specific guidance documents for data validation;
- Verification of the application of quality control (QC) limits for accuracy and consistency with the information stated in the guidance documents;
- Verification of the technical and completeness review results stated in the Data Validation Reports (DVR) for technical merit and overall quality; and,
- Verification of the project-specific field and analytical information for accuracy and consistency with the information stated in the QAPP.

General Comments

The DVRs provide a summary of QC parameters reviewed and an outline of the review of technical and completeness results of the data validation performed. No further details are provided for QC parameters meeting the acceptance limits. For outlying parameters, the DVRs provide attached tables identifying the affected analytes, outlying QC results, qualifiers and the associated samples qualified.

The DVRs do not indicate whether or not raw data and chromatograms were reviewed as part of the validation. The DVRs indicate the overall level of validation as "Auto Validation" for the XRF data and "Standard" for all other parameters. It appears that "Auto Validation" refers to validation information that was generated by Hydrometric's Automated Data Quality Review Program. Standard validation is defined as a review of the "Field and laboratory QC samples" and that the "samples associated with QC violations are flagged." It is unclear whether any of the raw results were recalculated and verified. The DVRs should be revised to provide the end data user with a clear understanding of the level of validation that was performed so that data usability may be assessed for decision-making purposes.

Overall Assessment

Overall, the data verification indicates that the data validation appears to have been performed per the requirements outlined in the National Functional Guidelines and the December 2000 Final QAPP for the ASARCO East Helena Facility.